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numerator are constants, $w^{\frac{2}{3}}u^{-2} + h^{\frac{2}{3}}v^{-2} =$ minimum when (3) is an equality, that is, when $u = v$. Hence $w/x = h^{\frac{1}{3}}/y$ and

$$y/x = h^{\frac{1}{3}}/w^{\frac{1}{3}} = \tan BAC \text{ as required.}$$

II. Solution by A. H. Holmes, Brunswick, Me.

A maximum length of pole would move with equal freedom on floor and side of tube, the condition being that the ratio between the part of the pole below the tube to the tangent of the angle it makes with the floor is equal to the ratio between the part of the pole within the tube and the tangent of the angle made by the extremity of the pole with the side of the tube, which is the cotangent of the angle made by the pole with the floor. Let h be the perpendicular height of the ceiling from the floor, w the diameter of the tube, and θ the acute angle made by the pole with the floor. Then we have

$$\frac{h}{\sin\theta} : \tan\theta = \frac{w}{\cos\theta} : \cot\theta.$$

Hence $\tan\theta = \sqrt[3]{h/w}$.

393. Proposed by H. E. TREFETHEN, Waterville, Maine.

Expand $\log[(\sin x)/x]$ in terms of x.

I. Solution by F. M. Morgan, Dartmouth College.

$$\sin x = x - \frac{x^3}{3\,!} + \frac{x^5}{5\,!} - \frac{x^7}{7\,!} + \cdots.$$

Hence

$$\frac{\sin x}{x} = 1 - \frac{x^2}{3\,!} + \frac{x^4}{5\,!} - \frac{x^6}{7\,!} + \cdots.$$

Now let

$$\frac{x^2}{3\,!} - \frac{x^4}{5\,!} + \frac{x^6}{7\,!} - \cdots = \gamma.$$

Then

$$\frac{\sin x}{x} = 1 - \gamma, \quad \text{and} \quad \log(1-\gamma) = -\gamma - \frac{\gamma^2}{2} - \frac{\gamma^3}{3} - \cdots.$$

Hence

$$\log[(\sin x)/x] = -\left(\frac{x^2}{3\,!} - \frac{x^4}{5\,!} + \cdots\right) - \left(\frac{x^2}{3\,!} - \frac{x^4}{5\,!} + \cdots\right)^2 - \cdots$$

$$= -\frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \cdots.$$

II. Solution by A. H. Holmes, Brunswick, Me.

$$\frac{d}{dx}\log[(\sin x)/x] = \cot x - \frac{1}{x}.$$

But

$$\cot x = \frac{1}{x} - \frac{x}{3} - \frac{x^3}{45} - \frac{2x^5}{945} - \cdots.$$

Hence,

$$\frac{d}{dx}\log\,[(\sin x)/x] = -\frac{x}{3} - \frac{x^3}{45} - \frac{2x^5}{945} - \cdots$$

from which by integration, we get

$$\log\,[(\sin x)/x] = -\frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \cdots$$

A solution similar to I was received from Levy M. Coffin.

GEOMETRY.

423. Proposed by C. N. SCHMALL, New York City.

The sum of the squares of the distances of a point from n fixed points is constant. Show that the locus of the point is a circle.

Solution by W. C. Eells, Tacoma, Wash.

Let (x_1, y_1), (x_2, y_2) $\cdots$ (x_n, y_n) be the coördinates of the n fixed points, and (x, y) of the moving point. Since $d_i = \sqrt{(x - x_i)^2 + (y - y_i)^2}$, the given condition may be expressed,

$$(x - x_1)^2 + (y - y_1)^2 + (x - x_2)^2 + (y - y_2)^2 + \cdots + (x - x_n)^2 + (y - y_n)^2 = k,$$

which reduces to

$$nx^2 + ny^2 - 2(x_1 + x_2 + \cdots + x_n)x - 2(y_1 + y_2 + \cdots + y_n)y + (x_1^2 + x_2^2 + \cdots + x_n^2) + (y_1^2 + y_2^2 + \cdots + y_n^2) - k = 0.$$

This may be expressed more briefly,

$$x^2 + y^2 - \left(\frac{2}{n}\sum_{i=1}^{n} x_i\right)x - \left(\frac{2}{n}\sum_{i=1}^{n} y_i\right)y + \frac{1}{n}\left(\sum_{i=1}^{n} x_i^2 + \sum_{i=1}^{n} y_i^2 - k\right) = 0.$$

This is a circle, with center at $\left(\frac{1}{n}\sum_{i=1}^{n} x_i, \frac{1}{n}\sum_{i=1}^{n} y_i\right)$, the square of whose radius is

$$\left(\frac{1}{n}\sum_{i=1}^{n} x_i\right)^2 + \left(\frac{1}{n}\sum_{i=1}^{n} y_i\right)^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i^2 + \sum_{i=1}^{n} y_i^2 - k\right).$$

Similar solutions were received from H. C. Feemster, S. W. Reaves, F. M. Morgan, Elmer Schuyler, and C. N. Schmall.

A solution of 418 was received from D. F. Kelley; one of 420 from C. N. Schmall, and one of 422 from H. E. Trefethen, after the list of solutions was made up and sent to the printer.

CALCULUS.

327. Proposed by RICHARD P. LOCHNER, Philadelphia, Penn.

A hound is at the middle point of the side of a square field, and a fox is at an adjacent corner. How far will the hound run to catch the fox if the fox runs on the perimeter of the field and the hound runs directly towards the fox at all times, the hound running n times as fast as the fox? Where will the race end?